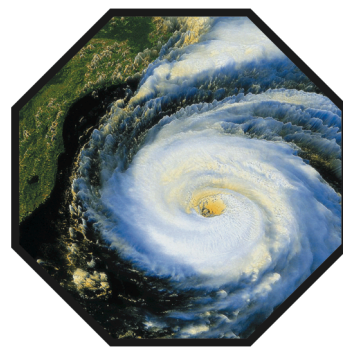


NASA SCIENCE MISSION DIRECTORATE

Earth-Sun System Applied Sciences Program Disaster Management Program Element FY 2005-2009 Plan



Version 1.1

March 16, 2005



*Expanding and accelerating the realization of economic and societal
benefits from Earth-Sun System science, information, and technology*

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NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Disaster Management Program Element

This document contains the Disaster Management Program Element Plan for Fiscal Years 2005-2009. This plan derives from direction established in the NASA Strategic Plan, the Earth Science Enterprise Strategy, the Space Science Enterprise Strategy, the Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the program element to serve the Applied Sciences Program, the Earth-Sun System Division, NASA, the administration, and society.

(Signature on file)

Stephen Ambrose
Program Manager, Disaster Management
Applied Sciences Program
NASA Earth-Sun System Division

February 11, 2005

Date

(Signature on file)

Lawrence Friedl
Lead, National Applications
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February 11, 2005

Date

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Director, Applied Sciences Program
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NASA Earth-Sun System Division: Applied Sciences Program Disaster Management

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NASA Science Mission Directorate – Applied Sciences Program

Disaster Management Program Element Plan: Fiscal Years (FY) 2005 - 2009

I. Purpose and Scope

This plan articulates the goals and direction of the Disaster Management Program Element for the period from Fiscal Years (FY) 05-09 by detailing the purpose of the program and our strategy to fulfill the disaster management mission with the resources available. The plan describes the Program's scope, including NASA's role in partnerships, the focus on decision support tools, and the types of Earth-Sun system science results we seek to extend. Within the Earth-Sun System Division, this plan functions as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that the Disaster Management activity will follow. The plan includes projects in which Earth-Sun system science results can be applied to decision making with related socioeconomic benefits.

The Disaster Management Program Element is one of twelve elements in the Science Mission Directorate's Applied Sciences Program. NASA and the Applied Sciences Program collaborate with partner organizations to enable and enhance the application of NASA's Earth-Sun system science results and exploration objectives to serve national priority policy and management decision-support tools. The desired outcome is for partner organizations to use project results, such as verification, validation, prototypes and benchmark reports, to enable expanded use of NASA science products and to enhance their decision-support tools, systems, and capabilities. The results of this work supports NASA's space exploration objectives to explore the Solar System and the Universe as well as NASA's research to operations transition objectives through the improvement in natural hazard identification for preparedness, response, and mitigation.

The Disaster Management Program Element extends products derived from Earth-Sun system science results information, models, technology, and other capabilities into partners' decision support tools for disaster management issues. The Disaster Management Program Element addresses issues of concern and decision-making related to volcanoes, geology, subsidence, earthquakes, drought, wildfire, hurricanes, climate, wind, tornadoes, space weather, and flooding planning, prediction, and forecasting. The Disaster Management Program Element is designed to advance the use of products from NASA's cadre of 30 Earth-Sun observation spacecraft to improve our knowledge of Earth system processes and instrument capabilities and to extend these benefits to society.

The Disaster Management Program Element focuses on decision support tools serving the following classes of issues related to the disaster cycle:

- Preparedness – Planning how to respond to a disaster
- Mitigation – Minimizing the effects of a disaster
- Response – Minimizing the hazards created by an emergency
- Recovery – Returning the community or environment to normal



NASA partners with Federal agencies and with regional-national organizations that have disaster management responsibilities and mandates to support disaster management managers. These include Local, State, Tribal and Industry partners. Partners include the U.S. Department of Homeland Security (DHS), the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the Federal Aviation Administration (FAA), the U.S. Department of Agriculture (USDA), and the U.S. Geological Survey (USGS). The Disaster Management Program Element includes international organizations and activities provided to advance NASA national priority science to the international community. Disaster Management Program Element's activities benefit the Aviation, Homeland Security, Energy Management, Ecological Forecasting, Public Health, Air Quality, and Water Management Program Elements. Through the Disaster Management Program, NASA provides results that support the White House Committee on Environment and Natural Resources (CENR)/Subcommittee on Disaster Reduction (SDR), Interagency Working Group on Earth Observations (IWGEO), World Summit on Sustainable Development (WSSD) and the interagency programs on Climate Change Science and Technology (CCSP, CCTP). This Program also works through such international agencies as the World Meteorological Organization/International Global Observing System (WMO/IGOS), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Committee on Earth Observation Satellites (CEOS), and other international countries and partners.

Priority NASA Science missions for the Disaster Management Program include Terra, Aqua, Aura, the Ice, Cloud, and land Elevation Satellite (ICESat), the Quick Scatterometer (QuikSCAT), CloudSAT, National Polar-orbiting Operational Environmental Satellite System (NPOESS), NPOESS Preparatory Project (NPP), Topography Experiment (TOPEX), Shuttle Radar Topography Mission (SRTM), Tropical Rainfall Measuring Mission (TRMM), Landsat, New Millennium EO-1, Jason, and Gravity Recovery and Climate Experiment (GRACE). Sensors include the Moderate Resolution Imaging Spectroradiometer (MODIS), Atmospheric Infrared Sounder (AIRS), Advanced Microwave Scanning Radiometer – E (AMSR-E), Lightning Imaging Sensor (LIS), SeaWinds, Enhanced Thematic Mapper (ETM), Ozone Monitoring Instrument (OMI) and other multispectral and visible sensor. Priority Science models include the Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model (MM5), Global Climate Model (GCM), ETA, Weather Research Forecasting Model (WRF), WAVEWATCH III, and other NASA application models. The project plans associated with the Disaster Management Program designate specific sensors and models and state specific partnership activities to extend NASA Science measurements, environmental data records, and geophysical parameters.

This plan covers objectives, projects, and activities for FY05-09. In FY04 the Program's priority activities focused on extending the ability of the DHS/FEMA "Hazards U.S. Multi-Hazard" (HAZUS-MH) Decision Support System (DSS) and of wind modeling for coastal flood inundation information, as well as improved earthquake information from the Southern California Integrated Global Positioning System (GPS) Network (SCIGN). In FY05, the Program's priorities focus on benchmarking the capability of HAZUS-MH using the WaveWatch III model and NASA data and evaluating the results from the 3-year SENH NRA projects funded in FY03. In FY06 the focus will be on the Advanced Weather Interactive Processing System (AWIPS) and wildfire support of the U. S. Forest Service Remote Sensing and Applications Center (RSAC) and the National Interagency Fire Center (NIFC). Because of funding cuts the AWIPS and RSAC goals are being deferred to FY06 objectives. These areas are for supporting the advancement and new generation of the NOAA NWS AWIPS, continuing the advancement of spacecraft observations and products into the current AWIPS system, and advancing knowledge of fire migration and emissions. There are a number of international initiatives related to sustainable development (WSSD), geoscience, tsunami/ocean monitoring, IWGEO, and GEOSS.

Scope within NASA and Applied Sciences Program

The Disaster Management Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Enterprise Strategy. The program element benefits from Earth-Sun system science results and capabilities including Operation System Simulation Experiments (OSSEs), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), the Earth-Sun System Gateway (ESG), and the Transition from Research to Operations (R2O). The program element utilizes initiatives such as the Global Information Grid (GIG) and Federal Enterprise Architecture (FEA) and cooperates with national Earth-Sun laboratories and international programs.

The FY05 President's Budget for the NASA Applied Sciences Program* specifies \$54M annually for FY05-FY09 for the National Applications (\$24M) and Crosscutting Solutions (\$30M) activities. While directly managing a subset of the \$24M National Applications budget, the Disaster Management Program Element (and each of the national applications) benefits from the performance results of the \$30M budget for Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). The Disaster Management Program Element leverages and extends research results from the approximately \$2.1B per year supporting Earth-Sun system science research and development of innovative aerospace science and technology.

Additional information about the NASA Applied Sciences Program can be found at <http://science.hq.nasa.gov/earth-sun/applications>.

** The National Applications and Crosscutting Solutions components of the Earth Science Applications Theme in the NASA FY05 Integrated Budget & Performance Document*

II. Goals and Objectives

The goal of the Disaster Management Program is as follows:

Enable partners' beneficial use of NASA Science research results, observations, models, and technologies to enhance decision support capabilities serving their disaster management, disaster warning, risk reduction, and policy responsibilities.

Major tenets of the Disaster Management Program's goals include the following:

- Develop and nurture partnerships and networks with appropriate disaster management organizations
- Identify and assess partners' disaster management responsibilities, plans, and decision support tools, and evaluate the capacity of NASA science results to support these partners
- Validate and verify application of science results with partners, including development of products and prototypes to meet partners' requirements
- With partners, document, verify, and validate the value of Science results in decision support tools and support the tools' adoption into operational use
- Communicate results and partners' achievements to appropriate disaster management communities and stakeholders
- Advance NASA exploration objectives in the new Science Mission Directorate where opportunities and Earth-Sun system science and applications enable the success of planetary and space exploration.

Objectives

The Disaster Management Program serves the NASA Strategic Plan Objectives 1.2 and 3.1, and the NASA Integrated Budget and Performance Document (IBPD) Performance Measures 5ESA2, 5ESA4, 5ESA6, 5ESA7, 5ESA8, and 5ESA9 (www.ifmp.nasa.gov/codeb/budget2004).

Specifically, the Disaster Management Program pursues the following short-term and long-term objectives:

Short-term Objectives (major milestones) (FY05-Early FY06 -- dates below in Calendar Year)

March 2005	Work with research community to develop tsunami risk map and corresponding flood inundation, incorporate global socio-economic information from CEISIN.
March 2005	Complete SDR Grand Challenges Report under the auspices of the OSTP/SDR.
August 2005	Schedule a results conference/workshop (May 2005) on satellite product benefits to the Disaster Management Program (SENH workshop). Complete SENH NRA closeout report (August 2005).
October 2005	Validate science inputs from at least one sensor and one model into at least two separate disaster management decision tools and policy/management activities – results from the MSFC LATEST Project. <i>Terra, Aqua, QuikSCAT, TRMM, ASTER, LandSAT, or EO-1</i>
October 2005	Establish agreements with at least two federal partners and at least one non-federal partner in disaster management (IMAAC MOU) Establish final report summary on nine projects funded through a Solid Earth and Natural Hazards (SENH) NASA Research Announcement (NRA) showing how projects met the integrated systems solutions diagrams and develop report from the SENH Workshop.
October 2005	Complete benchmark reports and conduct a results conference on science support to at least one disaster management decision support tool (HAZUS).
October 2005	By October 2005 publish at least three articles on disaster management applications of science, including at least one in a peer-reviewed journal (final deadline for 3 conferences/journals in planned in FY05) (Know Risk Book, 1 st Conference on Geo-Information for Disaster Management, IGARRS or AGU, other journals)

Long-term Objectives (FY06-09)

January 2006	Develop strategy for InSAR mission use towards applications for landslide, earthquake, ocean, and other hazards. Work with NOAA and USGS, and OSTP on decision support priorities. Incorporate space weather into disaster management priorities related to earthquake prediction and monitoring. Begin AWIPS DSS evaluation and enhancement of the AWIPS DSS.
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April/May 2006	Work with federal partners on utility of NPP products relevant to NASA risk reduction (MODIS to VIIRS for example). Establish MOU with USGS and NOAA on InSAR applications research.
June 2007	Establish TRMM to GPM applications transition/risk reduction development to support AWIPS decision support system.
January 2008	Prepare for NPP to NPOESS transition and capabilities to support AWIPS and HAZUS decision support systems. Work with USDA Forest Service on wildfire monitoring and risk reduction going from NPP to NPOESS.
June 2008	Prepare OSSE's for Aquarius products to enhance weather, climate and ocean applications and modeling through improved salinity observations for sea level monitoring.
January 2009	Complete transition of NPP to NPOESS products and prepare for next generation of earth observation satellites for the next decade.

III. Program Management and Partners

Program Management

Disaster Management Program Manager:

Stephen Ambrose, NASA-Headquarters

Responsibilities:

- Program development, strategy, plans, and budgets
- Program representation, advocacy, and issues to Applied Sciences Program management and beyond
- Communication of Applied Sciences Program priorities and directives to Disaster Management Program team/network
- Implementation of interagency agreements and partnerships
- Monitoring of Disaster Management Program metrics and performance evaluation
- Co-Chair of CENR/SDR/Remote Sensing Applications Working Group. Working Group guides Presidential policy on disaster management through this Office of Science and Technology Policy (OSTP) group of agencies

Disaster Management Co-Deputy Program Manager:

Dr. Rodney McKellip (acting), NASA-Stennis Space Center (SSC)

Responsibilities:

- Leadership on project plans, development, performance, and partnership relationships
- Communication of project metrics, performance, status, and issues to Program Manager
- Leadership and communication to Disaster Management Program team and network
- Coordination between NASA Centers on Disaster Management Program activities
- Management for grants funded through Stennis Space Center (SSC) and cooperative agreements
- Management of Disaster Management Program tasks at SSC

Disaster Management Co-Deputy Program Manager:

Dr. Shahid Habib, NASA-Goddard Space Flight Center (GSFC)

Responsibilities:

- Leadership on project plans, development, performance, and partnership relationships
- Communication of project metrics, performance, status, and issues to Program Manager
- Leadership and communication to Disaster Management Program team and network
- Coordination between NASA Centers on Disaster Management Program activities
- Management for grants funded through GSFC and cooperative agreements
- Management of Disaster Management Program tasks at GSFC

Partners

Primary contacts within NASA Centers and Federal partner agencies that are enabling NASA capabilities to the Disaster Management Program are listed below. This list is not exhaustive; only the primary program managers and focal points for specific and major projects or subject areas are provided.

NASA Center and HQ Contacts:

Mr. Ron Blom (Geology) - Jet Propulsion Laboratory (JPL)
Dr. James Brass/Vince Ambrosia (Wildfire) - Ames Research Center (ARC)
Dr. Steve Goodman (Weather, Severe Storms, AWIPS) – Marshall Space Flight Center (MSFC)
Dr. Shahid Habib (Hurricane, AWIPS, Landslide, Precipitation, Fire) – Goddard Space Flight Center (GSFC)
Dr. John Murray (Weather, U.S. Weather Research Program (USWRP) – Langley Research Center (LaRC)
Dr. Andy Negri/Dr. Bob Adler – Hurricane, Flood, Landslide Continuum
Dr. John LaBrecque – Geodetic Imaging, Hazard Research
Ms. Myra Bambacus – Geospatial Interoperability Office (GIO), GSFC
Dr. Gran Paules – Technology Division
Ms. Kitty Kavens – International and Interagency Activities
Ms. Elizabeth Williams – International Affairs
Dr. Nevin Bryant – JPL
Dr. Herb Frey – GSFC
Dr. Eric Lindstrum – NASA HQ; NASA POC for CEOS/UNESCO IOC
Dr. Roger Flaherty – GSFC/TDRSS Communications
Dr. Fran Stetina – GSFC – Cellular Phone technologies
Mr. Michael Pascioto – Technology Development Manager
Dr. Donald Deering – NEESPI – GSFC
Mr. Randal Albertson – DFRC
Dr. Ranty Liang – JPL
Dr. David Tralli – JPL, ISRSE
Ms. Elizabeth Plentovich – LaRC
NASA DAAC's
NASA Laboratories

Primary Partners

American Red Cross

Dr. Rocky Lopes – Disaster Services

Corps of Engineers (COE)

Mr. Andrew Bruzewicz – Office of Homeland Security

Department of Homeland Security (DHS)

Claire Drury – FEMA, Mitigation Division
Ed Laatche – FEMA, Program Policy and Assessment Branch
Chris Doyle – Science and Technology (S&T)
Nancy L. Suski – DHS, Emergency Preparedness and Response (EP&R Portfolio)
Dr. Bruce Davis – DHS, Emergency Preparedness and Response (S&T, EP&R Portfolio)
Mr. John J. Perry – FEMA, EP&R Remote Sensing Program
Mr. Cliff Oliver – FEMA HAZUS-MH Program Development

National Oceanic Atmospheric Administration (NOAA)

Ms. Helen Wood – NOAA National Environmental Satellite, Data and Information Service (NESDIS) (SDR Chair/IWGEO/GEOSS)
Ms. Donna McNamara – NOAA/NESDIS
Dr. David S. Green – NWS/AWIPS, Program Plans and Integration
Dr. Dan Tarpley – NESDIS/ORA
Mr. Gregory Withee – NESDIS/IWGEO/GEOSS
Mr. Gerry Dittberner – NESDIS/R2O
Mr. Dave Helms – NWS HQ/AWIPS
Mr. Frederick Branski – NWS/OFCM/ICMSSR
Dr. Frank Marks – Hurricane Research Division
Leroy Spayd – NWS HQ MSD

State Department

Mr. Alan L. Davis – Humanitarian Information Unit (HIU)
Mr. Larry Roeder – State Department (WCDR)/GDIN
Ms. Tiffany Hill – GIS Intelligence Consultant/HIU
Dr. Fernando R. Echavarria – Space and Advanced Technology Staff

United States Geological Survey (USGS)

Ms. Roz Helz – USGS, Earthquakes and Volcanoes (SDR/RSAWG)
Mr. Tim Cohn – USGS (SDR Representative, Grand Challenges Representative)
Dr. Wayne Thatcher – USGS, Menlo Park, GPS Networks
Dr. Nina Burkardt – Fort Collins Science Center
Ms. Jean Weaver – Coordinator for Central America, S. America, Caribbean
Dr. Randy Updike – USGS
Dr. David Applegate - USGS

United States Department of Agriculture (USDA)

Mr. Tom Bobbe – Forest Service, Remote Sensing Applications Center
Mr. Paul Greenfield – Forest Service Headquarters/USDA MOU
Dr. Susan Conard – U. S. Forest Service
Dr. Diane Petrino – USDA Food Security
Dr. Wei Min Hao, Fire Chemistry Project
Mr. Douglass Shinn – Forest Service, Fire and Aviation Management
Ms. Alice Forbes – NIFC, Director Operations

Industry

Dr. Robert Ryan – Lockheed Martin/SSC
Dr. Lisa Warneke – Consultant/IAGT
Dr. Timothy Gubbels – SAIC
Dr. Tim Foresman – ICRSE
Ms. Mary Ellen Brown – GeoData Systems
Mr. Ronnie Yaron – Skyline Software
Ms. Sue Gray – Sky Research, Inc

Mr. Tom Strange – General Dynamics, SSC
Mr. Brian Tucker – Geohazards International

University

Dr. Douglas Stow – Sand Diego State University/REASoN
Dr. John Jensen – U of S. Carolina/REASoN
Dr. Ray Williamson – George Washington University/Space Policy Institute
Dr. David W. S. Wong – George Mason University
Dr. Richard Gomez – George Mason University
Dr. Linda Musial – Charles County Public Schools/Outreach/Education
Dr. William Craig – U. of Minnesota
Dr. Michael A. Rosenblum – MIT
Dr. Arlin Kruger – U MD
Dr. Michael Hodgson – U. S. Carolina
Dr. Menas Kafatos – George Mason U.

State, Local, Tribal

Mr. John H. Talley – Delaware State Geologist
Maurice A. Tatlow – Arizona Hydrologist
Tim Haithcoat—University of Missouri, Columbia

Secondary Partners

International, National, and Regional Organizations

Mr. Michael Hales – NOAA/NESDIS International Affairs - CEOS – World Summit on Sustainable Development (WSSD)
Dr. Pricilla Nelson, Dr. Dennis Weneger – NSF
State Department, Humanitarian Information Unit (HIU)
Mr. James Weber – International Symposium on Remote Sensing of the Environment (ISRSE) Organization
Dr. Charles Hutchison – University of Arizona
Dr. Thomas Schaff/Dr. Mario Hernandez – UNESCO
Dr. Lisa Vandemark – NRC
Mr. Jim McNitt – OFCM
Dr. Dusan Sakulski – United Nations University
Dr. Louis Buys – Dept. of Provincial and Local Governments, S. Africa
Dr. Alain Retiere – United Nations Institute for Training and Research
Dr. Sergey Pulinets – Instituto de Geofisica – Mexico
Dr. Leonid Bobylev – NIERSC
Jean-Paul Malingreau – European Comisión
Robert Missotten – UNESCO MOU
Dr. Walter Erdelen – UNESCO
Dr. Josef Aschbacher – ESA/TIGER
Dr. Nina Novikova – Russian Aviation and Space Agency
Dilip Kumar Ratha – World Bank, Senior Economist
Lasse Pettersson – NIERSC
Dr. Marcio Babosa – UNESCO Deputy Director General

Domestic

Climate Change Technology Program (CCTP)– The Office of Science leads a CCTP task group on measurements and monitoring supported by the Disaster Management Program.

The Climate Change Science Program (CCSP)– A joint federal program of the President’s Committee on Climate Change Science and Technology Integration has issued its strategic plan to address some of the most complex questions and problems dealing with long-term global climate variability and change.

U.S. Weather Research Program – Weather research initiative to improve weather modeling through intensive field campaigns.

Solid Science Working Group (SESWG) – Blue-Ribbon panel produced document on solid Science and research.

CENR Subcommittee on Disaster Reduction (and associated Working Groups) – Office of Science and Technology Policy (OSTP) subcommittee and joint effort from all Federal agencies; NASA is co-chair of the Remote Sensing Applications Working Group (RSAWG)

Geospatial One Stop (GOS) – GIO collaboration to bring interoperability to the federal community.

Federal Geographic Data Committee (FGDC) – NASA participates in the standards committee for Homeland Security and Geographic Information.

Global Learning and Observations to Benefit the Environment (GLOBE) - Disaster Management played a role in the selection of the current contractor, University Corporation for Atmospheric Research (UCAR), and continues to participate in GLOBE-sponsored events and school visitations.

Interagency Program Office (IPO) for NPOESS – This interagency office that has NASA representation is participating in assessing and validating future NPOESS instruments and science.

Interagency Working Group on Earth Observations (IWEGO)

International

International Global Observing System – Through the Earth Observation Summit and the World Meteorological Organization, NASA SMD contributes by providing NASA capabilities for research.

Global Climate Observing Strategy (GCOS) – NASA participates in international meetings related to GCOS and related data management issues.

World Summit for Sustainable Development (and 4 Working Groups) – the Disaster Management Program leads *Module 3 – Disaster Management and Conflict* of the type-2 partnerships under the WSSD and partners with other space agencies involved in WSSD.

International Symposium on Remote Sensing of the Environment (ISRSE) NASA plays a lead role in the bi-annual conference.

Ad Hoc Group on Earth Observations (GEO)

The Disaster Management Program interacts with the Nation Applications, Crosscutting Elements and other science programs (e.g., Education, Outreach, Space Weather, DEVELOP, and GIO) to support appropriate projects.

IV. Decision Support Tools

Priority Decision Support Systems for FY05:

HAZUS-MH

The HAZUS-MH Loss Estimation Tool is a Geographic Information System (GIS) based DSS tool developed by the U.S. Federal Government for estimation of loss caused by natural hazards and other disasters. FEMA oversees HAZUS-MH activities at large, whereas the National Institute for Building Sciences (NIBS) manages this tool's development and implementation for use by the Federal, State, and municipal emergency management communities. FEMA initially released HAZUS in 1999 as HAZUS-99 SR2, primarily as a tool for earthquake disaster risk assessment. HAZUS was expanded in the past year to include hurricanes (wind) and flood assessments (coastal included).

Each HAZUS-MH module (earthquake, wind, flood) allows the user to map, assess, and display geospatial data pertaining to a specific natural hazard to assess and mitigate hazard risk. HAZUS-MH also enables estimation of physical damage to buildings, critical facilities, and other infrastructure. In addition, each hazard-specific module gives estimates of economic loss (e.g., lost jobs, business interruption, repair costs, construction costs) and social impacts (e.g., identifying requirements for shelters and medical aid) from a variety of census tract information.

NASA's role in HAZUS-MH is to benefit the HAZUS-MH application through the infusion of NASA Science research results. For example, during FY04 NASA funded an activity to enhance HAZUS-MH in its ability to determine wind and wave assessments using the WaveWatch III model (a NASA derived model modified by NOAA). NASA observation technologies and modeling expertise in wind and digital elevation modeling, through QuikSCAT and ASTER sensors, respectively, can improve the HAZUS-MH DSS through broader observations and improvements to HAZUS-MH models. Surface roughness characteristics were also studied under this contract and in collaboration with Stennis Space Center. This project is in its second year and V&V and benchmark results should be delivered near the end of FY05 or beginning of FY06.

Advanced Weather Interactive Processing System (AWIPS)

A high-speed, technologically advanced weather processing, display, and telecommunication decision support system called the Advanced Weather Interactive Processing System (AWIPS) is the centerpiece of National Weather Service operations. AWIPS is an interactive computer system that integrates all meteorological, hydrological, satellite, and radar data into one computer workstation that forecasters use to create their daily products at some 150 Weather Forecast Offices (WFO) and River Forecast Centers (RFC). AWIPS allows forecasters the interactive capability to view, analyze, combine, and manipulate large amounts of graphical and alphanumeric weather data, such as weather, flood, air quality, and marine weather forecasts. NOAAPORT, the NOAA portal to data and information served to AWIPS and other users of

meteorological, hydrological, and oceanographic data and is the communications arm to the weather community.

AWIPS utilizes a number of spacecraft products and applications that can be enhanced by NASA research and applications. When partnered with NOAA, NASA products can improve the information provided to NWS field offices. This partnership will advance data processing, archive, transmission, and display of spacecraft information for the weather forecaster.

The Disaster Management Program works with NOAA to improve AWIPS' ability to incorporate more of NASA's assets into the meteorologists' decision-making processes. For example, TRMM satellite observations of lightning can improve NWS forecasts of severe weather. The NASA Short-term Prediction Research and Transition (SPoRT) Center is improving lightning detection methods and is working with the NWS Southern Regional Headquarters to put this information into the hands of forecasters. The SPoRT facility is a central NASA center for incorporating NASA research results to the AWIPS user community.

In addition to providing NASA remote sensing and modeling capabilities, NASA has a wealth of data management, data communications, high performance computing, and complex modeling experience that may provide significant improvement to AWIPS as AWIPS develops the next generation decision support system. By providing the NOAA with NASA satellite expertise and data communications experience, NOAA can enhance the AWIPS to provide more satellite data and model outputs to the NWS field offices and users of NOAAPORT. Increases in satellite utilization with future NPOESS and NPP data, along with improved communications and data processing capabilities essential to maximizing AWIPS' usefulness will be the goal in FY05 as AWIPS continues to operate and the next generation of AWIPS gets underway.

FY06 will be a year of evaluation of AWIPS as well as development of current projects focused on the NWS Southern Region, both in its current operation as well as for development of its next generation system. This program will work closely with the crosscutting applications that deal with high performance computing, systems integration, and systems communications to better enhance AWIPS as the system is re-developed for NWS operations.

Remote Sensing Applications Center (RSAC)

In response to demand from agency managers, who are increasingly challenged by complex problems during the fire and fuels planning and post fire restoration processes, fire research and development (R&D) has expanded programs on management of fire and fuels, predicting effects of fire, and social and community processes, while continuing to develop improved products to support fire suppression for applications.

Examples of recent tools and products in response to these challenges include¹:

- 1) A fire growth simulator for assessing wildfire growth potential and fuels treatment priorities (FARSITE);

¹ "Wildland Fire Research and Development: Meeting the Needs of the Present; Anticipating the Needs of the Future," U.S. Forest Service, February, 2005.

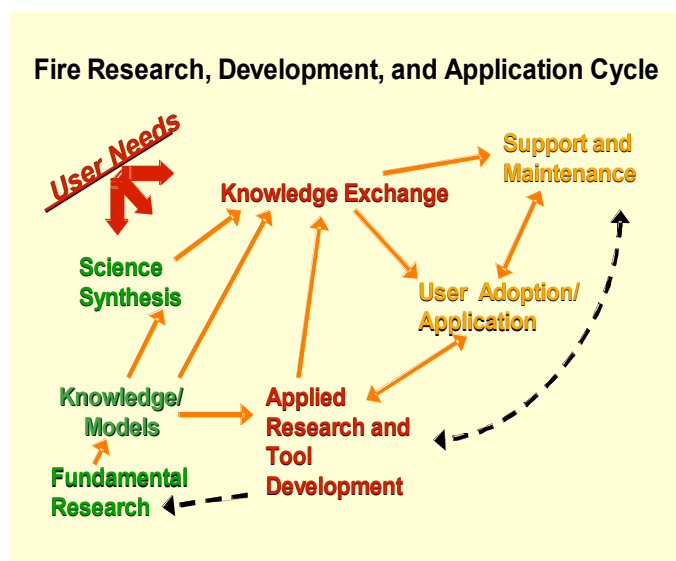
- 2) A modeling framework to predict cumulative smoke impacts from forest, rangeland, and agricultural fires (Blue Sky/RAINS);
- 3) A multi-agency, inter-disciplinary product designed to produce geospatial data of vegetation conditions, fire fuels, risks, and ecosystem status at the national, regional, and local scales (LANDFIRE).

The Disaster Management Program works with the USDA Forest Service and related agencies to enhance their decision support system for wildfire management.

For example, the RSAC of the U. S. Forest Service utilizes NASA satellite observations for wildfire monitoring, mitigation, and response. Information from the RSAC is fed across the U. S. Forest Service to a number of response teams. This information is also delivered to the National Interagency Fire Center, a decision support center for national fire coordination.

The decision support system used by the NIFC is FIREWISE. The FIREWISE system is a homeowner, firefighter, and education system to help prepare, mitigate, and improve a residence, business, and community against wildfires.

Forest Service has developed an architecture towards applications. This illustrates this complex cycle of research, development, and application they have developed.



Forest planning decision support systems of interest include such models as ArcForest, ARGIS, IMPLAN, INFORMS, KLEMS, LANDIS, MAGIS, NED, RELMdss, SARA, SIMPPLLE, SNAP, SPECTRUM, TerraVision, UTOOLS, Woodstock and others (Mowrer 1997).

Disaster Management Issues

The Applied Sciences team continually consults with its partners to identify important issues facing the disaster management community, to examine associated decision support tools, and to determine priorities within the disaster management portfolio. Topics are listed below with application partners given in parentheses.

- Severe weather/AWIPS (SPoRT Center/lightning detection/NWS)
- International disaster management issues and coordination (CEOS-WSSD, Type-2 partnerships, ESA, Earth Observation)
- Earthquake, deformation, landslide prediction improvements result from Interferometric Synthetic Aperture Radar (InSAR/Restless Planet Initiative) and other techniques to predict earthquakes or the precursors to earthquakes
- Humanitarian Information and Geospatial Improvements to Global Monitoring (State Department and Pacific Disaster Center/Center of Excellence)
- Disaster Management Policy and Grand Challenges (Subcommittee on Disaster Reduction (SDR), National Research Council, and National Science Foundation)
- Disaster Issues of Relevance for the Nation – The National Academies Disaster Roundtable

V. Application Activities

A. Projects

The Disaster Management Program authorizes directed and partners with solicited projects to support the Program's goals and objectives. The respective project managers are responsible for developing project plans, proposals, or work plans and for managing activities to support the Program, the Science Directorate, and its partners in the following projects.

Project Plans specify Earth-Sun System Science research, observations, models, and other outputs for the potential use in decision support tools identified in this Program Plan. Where multiple project managers are specified, each has a specific role in the project managed at a NASA Center or Research Laboratory. Project Plans are submitted to the Program Manager and Deputy Program Manager for review and approval. When needed peer review is performed as well as partnership potential with the other eleven National Applications in the Applied Sciences Program.

Project Hurricane, Flood, Landslide Continuum - Deformation, Landslides, Mudslides					
Purpose: To insert NASA’s remote sensing technologies from remote sensing measurements and models into AWIPS DSS for earthquakes, deformation, and landslides. Goals: To transfer NASA’s Science results to decision support systems for landslide information, primarily focused on the Caribbean region then to National Priorities. To improve forecasting capabilities for landslides induced by earthquakes and rainfall.				Budget (K)	
				FY05	150
Project Managers	Centers	Timeframe	Partners	FY06	400
Shahid Habib – GSFC Andy Negri – GSFC	GSFC	FY05-FY09	DHS/FEMA/USGS/NOAA	FY07	300
				FY08	200
				FY09	200
Earth-Sun System Science Products	SRTM, InSAR, Terra, Aqua, Aura, TRMM			Other Apps.	
Deliverables	1) Improved landslide assessments for HAZUS-MH and AWIPS and other decision centers. Through GSFC and their hurricane/landslide program, new techniques for providing input using TRMM, NPP, NPOESS, GPM for precipitation data and hurricane applications			Aviation Water Management	

Project Flood for WSSD					
Purpose: Working with the International Community, partner with projects relevant to NASA Applied Sciences Program for the advancement of NASA science for decision support. NASA has Module 3 leadership under the CEOS WSSD Type-2 partnerships, leverage NASA grants to be applied to WSSD partnerships in Africa. A component of this work will be to work with the SENH community towards advancement of their research results to international applications.				Budget (K)	
				FY05	150
Project Managers	Centers	Timeframe	Partners	FY06	150
Dr. Bruce Davis – SSC	SSC	FY05-FY09	Congressionally Mandated programs, REASoN, SENH	FY07	300
Dr. Shahid Habib – GSFC				FY08	100
				FY09	100
Earth-Sun System Science Products	SRTM, ASTER, ALI, Landsat, Terra, Aqua, QuikSCAT			Other Apps.	
Deliverables	1) Establish projects with Module 2 of ESA’s TIGER program with S. Africa investigators. 2) Establish projects with USC, and U of Miss, and Dartmouth University in collaborations with WSSD and TIGER.			Aviation, Public Health, Agriculture, Water Management	

Project Wind, Surface Roughness, WaveWatch for HAZUS-MH					
Purpose: To insert NASA’s Science results into HAZUS-MH capabilities with remote sensing and model development for wind and wave assessments. Goals: Provide improved remote sensing data sources for HAZUS-MH hurricane, wind, and surge models to include NASA remote sensing technologies, such as TRMM, QuikSCAT, and MODIS. Validate surface roughness parameters (sensitivity analysis) for this application as well as satellite input improvements. Project was funded in FY04 for completion in FY05.				Budget (K)	
				FY04 funds used in FY05	
				FY05	0
Project Managers	Centers	Timeframe	Partners	FY06	0
Bruce Davis – SSC	SSC	FY05-FY09	DHS/FEMA/NOAA NIBS/ARA. REASoN	FY07	0
				FY08	0
				FY09	0
Earth-Sun System Science Products	WAVEWATCH III, ASTER, ALI, Landsat, Terra, Aqua, QuikSCAT			Other Apps.	
Deliverables	3) Verify, validate, and benchmark WAVEWATCH III results to use remote sensing inputs for improved wave/surge calculations for HAZUS-MH 4) Advance the production of the NOAA Hurricane Wind (H*Wind) into operations for HAZUS support.			Aviation, Public Health, Agriculture, Water Management	

Project AWIPS					
Purpose: To apply NASA’s Science results to utilize remote sensing and model development for improvements and the development of the next generation of AWIPS. Goals: Validate improvements of NASA remote sensing technologies, such as LIS, Landsat ETM, SeaWinds, and MODIS to AWIPS.				Budget (K)	
				FY05	0
Project Managers	Centers	Timeframe	Partners	FY06	150
Bruce Davis – SSC Shahid Habib/Bob Adler Doug Rickman, Steve Goodman - MSFC	SSC, GSFC, MSFC	FY05-FY09	NOAA, FSL, UCAR and other labs	FY07	150
				FY08	300
				FY09	100
Earth-Sun System Science Products	Lambda Rail, HPCC, Web Map Services, Integration Systems, Satellite Data and models			Other Apps.	
Deliverables	1. Evaluation of AWIPS through a three center evaluation process to identify potential collaborations of NASA across spacecraft data, archive, data management, communications, high performance computing, and advanced computer hardware. 2. Use this evaluation to plan for future projects for V&V and Benchmarking and participation in AWIPS Next Generation development for the NWS.			Aviation, Public Health, Agriculture, Water Management	

Project WildFire (Remote Sensing Applications Center, NIFC, FIREWISE)					
Purpose: To evaluate NASA’s science results in land use/land cover to benefit RSAC Forest Service, and NOAA capabilities with remote sensing and model development for wildfire detection, mitigation, and response. Goals: Improve wildfire assessments at the RSAC that feed information to the NIFC decision support center using TRMM, QuikSCAT, and MODIS.				Budget (K)	
				FY05	0
Project Managers	Centers	Timeframe	Partners	FY06	150
Bruce Davis – SSC Vince Ambrosia – ARC	SSC, ARC	FY05-FY09	DHS/FEMA/USGS/NOAA /USDA/FS REASoN	FY07	300
				FY08	100
				FY09	200
Earth-Sun System Science Products	MODIS Rapid Response, Fire Fuels Modeling, Vegetation Stress, Sensorweb			Other Apps.	
Deliverables	1. Coordinate the needs of the wildfire community to provide requirements for wildfire assessments related to property damage. 2. Integrate MODIS Rapid Response image analysis into fire response planning. 3. Leverage off REASoN, WRAP wildfire project results. 4. MODIS Direct Broadcast workshop in collaboration with UMD			Aviation, Public Health, Agriculture, Water Management	

Project MODIS-VIIRS Land Processing System (Risk Reduction/Research to Operations)					
<p>Purpose: To integrate the MODIS Land Rapid Response System (MLRRS) into NOAA and USFS Operations. Project Title: MODIS-VIIRS Land Surface Processing System. The U. S. Forest Service is coordinating a proposal in conjunction with the U. of Maryland. This work will move from an experimental system to operations and prepare NOAA for Visible/Infrared Imager/Radiometer Suite (VIIRS) instrument data from NPOESS and NPP. NASA will enable NOAA with the ability to transition the research to operations. NOAA will take on the operation.</p> <p>Enable collaboration with the NASA SERVIR activity of Ecological Forecasting related to fire management. The project is also linked to the Science Directorate effort to improve Research to Operations from NASA to NOAA.</p>				Budget (K)	
				FY05	0
Project Managers	Centers	Timeframe	Partners	FY06	155
Shahid Habib - GSFC Bruce Davis - SSC	HQ, GSFC, SSC	FY05-FY09	NOAA (ORA/SSD), UMD, Regional Visualization and Monitoring System (SERVIR)	FY07	75
				FY08	50
				FY09	0
Earth-Sun System Science Products	MODIS Rapid Response Product (U. of Maryland Project)			Other Apps.	
Deliverables	Demonstration after first year of Operational MLRRS at NOAA operations. Algorithms meet operational requirements for a fully operational product and risk reduction analysis. Project to accelerate when agreement and commitment of NOAA signed. Chris Justice and Ivan Csizar, P. I.'s for this activity, although Forest Service is also interested and may perform work in this area under the USDA/NASA MOU			Air Quality, Aviation, Ecological Forecasting	

Project AWIPS (LATEST project)					
Purpose: To integrate NASA’s research in lightning and severe storms into the NWS Advanced Weather Interactive Processing System operations, including the development of interoperable operations for AWIPS and geospatial access to AWIPS satellite products.				Budget (K)	
				FY05	98
Project Managers	Centers	Timeframe	Partners	FY06	0
Steve Goodman/Doug Rickman – MSFC Bruce Davis - SSC	MSFC (SPoRT), GSFC, SSC	FY05	NOAA/NWS/NESDIS, FAA, DOD	FY07	0
				FY08	0
				FY09	0
Earth-Sun System Science Products	LIS, Wind and Precipitation Products			Other Apps.	
Deliverables	1. Integrated NASA technology and data assimilation into NWS AWIPS Operations. Transfer of NASA interoperability knowledge to NOAA AWIPS developers. (LATEST Project)			Air Quality, Aviation, Water Management	

Inter Application Activities

The Disaster Management Program crosscuts the other 11 National Applications in the Applied Sciences Program. Specific crosscutting activities related to Homeland Security, Aviation, Air Quality, Agriculture, Carbon Management, and Water Management are currently underway and others are anticipated.

Crosscutting Solutions is the program in the Applied Sciences Program that not only links each of the national applications, but advances science, technology, communications, computing, and interoperability methods and research for the advancement of national applications.

The Disaster Management Program also has a strong connection to the Solid Earth and Natural Hazards Program of the Solar System Science Division. This Program directly links to disaster management activities for applications of remote sensing in detecting and predicting earthquakes, landslides, and volcanic activity; another Division link relates to Land Use/Land Cover research activities concerning wildfires, carbon cycle, and agriculture.

Disaster Management is also closely tied to the Crosscutting Space Weather application and will utilize the expertise of the space science community to establish linkages to disasters either caused by or complicated by sun-solar activity.

Research to Operations

The R2O (Transition from Research to Operations) Network sub-element focuses on systematically transitioning the results of research conducted through nearly 2000 affiliated research grants to operational uses. The approach is to evolve a network of the Earth-Sun System science research organizations with corresponding operational organizations.

The R2O Network is a systems approach to enable holistic solutions to benefit society by enabling the connection of discrete capacities developed in distributed research organizations to be networked together and transitioned to operational configurations. The objective is to enable solutions that are greater than the sum of the parts. During the past five years, the former Earth Science Enterprise administered (on average) approximately 2000 individual funded projects per year. These projects included approximately 1500 research grants, 100 Earth observation technology and systems projects, 200 education grants, and 200 Applied Sciences Program grants. The challenge in achieving the goals and objectives of the Agency, Directorate, and Division—in order to deliver results that reflect the mission “to understand and protect the home planet”—is the need to connect and integrate the results of distributed science and technology research and development into focused solutions that are targeted at specific societal benefits.

Human Capital Development

This activity is primarily accomplished through DEVELOP, a student-based applications and advanced prototyping program. Students from high schools and universities throughout the country (currently 29 states are represented) use network and systems approaches in a structured project environment to research issues of community concern based on requests from state, local

and tribal governments. Students (from graduate to high school) are sponsored to develop prototype solutions based on Earth-Sun System science results including space-based observations, science models, and enhanced decision support systems. The results are demonstrated at high-level regional or national forums such as Governors' conferences, showcasing the utility of Earth-Sun Science knowledge. DEVELOP fills a niche for rapidly prototyping solutions for local applications with the benefit of developing intellectual capital for extending capacity to be adopted or adapted for national, regional, or international applications.

Geosciences Standards and Interoperability

The primary activity is the development and evolution of the Earth-Sun System Gateway. The Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results, including Earth observations, models, algorithms, predictions, education modules, data assimilations, and integrated system solutions.

GEO also has a focus on serving NASA commitments to the Federal Geographic Data Committee (FGDC), Geospatial One Stop (GOS), and the President's Management Agenda, and E-Government initiatives to facilitate development of, and compliance with, national and international standards and interoperability protocols for exchange of data and information produced by Federal agencies.

Integrated Benchmarked Systems Program (IBS)

The Integrated Benchmarked Systems Program is that part of the Crosscutting Solutions Program whose objective is to provide the systems engineering services and support to perform evaluation, verification, validation, and benchmarking required by the twelve Applied Sciences Programs. System engineering services and support includes such activities as system design, synthesis, integration, requirements analysis, testing, verification, validation, and uncertainty analysis.

The goal of the Integrated Benchmarked Systems Program is to assure the integrity, quality and reliability of innovative solutions delivered by the Applied Sciences Program to its customers, thereby enhancing the decision-making capacities of partner agencies and their customers.

The Disaster Management Program Element utilizes the IBS Program to evaluate, verify, validate, and benchmark the solutions used to improve decision support tools, such as the HAZUS-MH and AWIPS systems. More information on schedule and deliverables can be found in the IBS Program plan. This includes the requested amounts from the IBS Program to support the Evaluation, Validation, and Benchmarking of the NASA's Science research results into HAZUS-MH.

Disaster Management Program Management: Integrated System Solutions Diagram (see Appendix A)

B. Solicitations

Several Research, Education, and Applications Solutions Network (REASoN) projects managed by SSC are assigned to the Disaster Management Program. Two projects are fully funded by REASoN and one project is jointly funded by REASoN, Code M, Code YS, and Code YO as described below:

1. University of South Carolina – “Development of Remote Sensing-assisted Natural and Technological Hazards Decision Support System” – Improve the utilization of NASA data sources, modeling, and systems engineering in disaster management and homeland security. Model human risk and vulnerability to hazards; develop system for rapid identification of remote sensing assets. Channels new NASA data sources into disaster management applications. Responds to the FEMA DSS – well connected with user organizations. Linked with the WSSD Module 3 project described in this plan. Project builds on existing capabilities by stakeholders. The total amount of REASoN funds for the five-year project is \$2,054,323; FY04 is \$616,696.
2. NASA Wildfire Response Research and Development, Applications and Technology Implementation, Vince Ambrosia, P. I. Collaboration with the U.S. Forest Service to extend the use of NASA data sources, modeling, and systems engineering to tactical wildfire response. The project: Benchmarks the use of UAVs and improved telecommunications for disaster management with potential extension to Homeland Security; Combines existing technology with new platforms and instrumentation to address decision support requirements in tactical situations; Responds to high priority research and operational needs of the USFS partner; and, Collaborates closely with the Rochester Institute of Technology (RIT), which who received a Congressionally-directed project in FY2004 and FY2005. The total amount of REASoN funds for the five-year project is \$2,643,082; FY04 is \$600,000.
3. Center for Real-Time GPS Data and Products, P.I. Yoas Bar-Sever, JPL. This project improves GPS technologies and in turn improves GPS earthquake monitoring stations. Funding: \$100K from REASoN for 5 years, \$100K from Applied Sciences, and \$400K for 5 years from other sources. The Disaster Management Program does not manage this project but contributes to the goals of improved GPS systems. Funds for this project are expected to come from the Program Director’s funds.

The Disaster Management Program plans to participate in a joint project solicitation for projects beginning in FY05 through the Applied Sciences Program “Decisions” solicitation. The Program plans to coordinate the disaster management priorities with EPA, DHS/FEMA, USDA, and others.

In addition, the Disaster Management program will work under the Science Mission Directorate structure for solicitations called ROSES (Research Opportunities in Space and Earth Sciences). In 2005, the NASA Science Mission Directorate (which incorporates both the Office of Earth Science and the Office of Space Science) will release a single NRA entitled Research Opportunities in Space and Earth Sciences - 2005 (ROSES-05). The ROSES-05 announcement includes the foci of the five to ten individual Earth Science NRA’s that have been routinely

released by the Office of Earth Science in previous years. The ROSES-05 NRA includes all on-going research opportunities in Earth and Space science that NASA has traditionally sponsored and is the solicitation for proposals leading to selections of research tasks to be funded in Fiscal Year 2006. Research opportunities are referred to in this NRA as "program elements." The ROSES-05 NRA may be found at: <http://nspires.nasaprs.com/external/>.

C. Congressionally Directed Activities

Activity: Congressionally directed projects at RIT

Purpose: To develop a wildfire monitoring system for first responders called "Wildfire Airborne Sensor Program" (WASP). This program, closely integrated and coordinated with the Forest Service and NASA, will develop an airborne sensor capability to respond to wildfires.

Managers: Steve Ambrose, Bruce Davis (SSC), Jim Brass (JPL)

Goals: FY04 – To collaborate with RIT, JPL, and other centers to make sure RIT is aligned to NASA objectives related to fire monitoring

Budget: \$1,200K

Activity: Congressionally directed project at the University of Miami, Center for Southeastern Tropical Advanced Remote Sensing (CSTARS)

Purpose: To further develop the data center to serve the needs of the research community. This center's spacecraft access now reaches to Central America, and its activities in obtaining commercial spacecraft data for research has been exceptional.

Managers: Steve Ambrose, Bruce Davis (SSC), Callie Hall (SSC)

Goals: FY04 – Develop CSTARS' capabilities for ingesting a variety of spacecraft data from federal and commercial data sources. Recently SPOT was added to the list of available spacecraft agreements. Tim Dixon is the CSTARS manager.

Budget: \$1,800K

Activity: Congressionally directed project at the Cayuga State College, RACNE, IAGT.

Purpose: To develop geoscience technologies for state, local, and tribal communities.

Managers: Steve Ambrose, Paul Deminco (GSFC)

Goals: FY05 - To establish improved partnerships with IAGT, Affiliated States, and homeland security community;

To partner with SERVIR, GIO, and other NASA projects that utilize geospatial data and visualizations.

Budget: \$1,800K

D. Project Management

The Disaster Management Program Element authorizes studies, working group participation, program reviews, and other endeavors to ensure the Program's overall success.

Activity: CENR Subcommittee on Disaster Reduction and related Remote Sensing and Applications Workgroup

Purpose: Guide Presidential policy on disaster management through this OSTP group of agencies

Manager: Stephen Ambrose, NASA HQ

Goals: The SDR coordinates and creates policy documents that are reviewed by agencies and signed by the OSTP CENR. For example, the first document completed this year was “Reducing Disaster Vulnerability through Science and Technology.” This collaborative document identified current disaster risks and agency activities. In FY04, SDR activities are structured to work closely with the Earth Observation Summit activities and implementation plans, both nationally and internationally, as well as to improve interagency coordination of challenges facing the hazards community.

Activity: U.S. Weather Research Program (USWRP)

Purpose: NASA participates in USWRP activities, such as THORPEX. The SPoRT Center at MSFC participates in severe weather research to benefit model inputs to USWRP research activities.

Managers: John Murray (LaRC), Steve Goodman (MSFC)

Goals: Ensure NASA assets are included in program experiments under the USWRP.

Activity: Consortium for International Science Information Network (CEISIN)

Purpose: Socioeconomic DAAC and Socioeconomic Data and Applications Center (SEDAC)

Managers: Steve Ambrose

Goals: Integrate applications with socioeconomic data; Establish partnerships with humanitarian and sustainable development organizations to establish joint projects. Work with earthquake community to establish risk assessments linked to population data. Bob Chen is the CEISIN DAAC manager.

Activity: State Department Partnership, Humanitarian Information Unit

Purpose: Work with the State Department in implementing DSS for the HIU. Coordinate geospatial data inputs with the GIO.

Managers: Steve Ambrose, Rodney McKellip (SSC), Myra Bambacus (GIO)

Goals: Demonstrate NASA capabilities to improve interoperability and humanitarian support. Work with State Department, HIU, CENR, GEOSS to establish coordination for a global tsunami warning system.

Activity: Committee on Environmental Information Systems and Communications (CEISC)

Purpose: Coordinates under the OFCM policy and requirements in support of earth observations and systems, a subcommittee of the ICMSSR. Mr. Fred Branski and Michael Howland co-chairs.

Manager: Steve Ambrose

Goal: Interagency coordination of observing system requirements, new technologies, frequency management, and other issues.

Activity: Natural Hazards Research and Applications Center

Purpose: To include societal impacts of disaster management in the program element; This center is supported by NASA to advance the understanding of hazards’ impacts on society. The Disaster Management program manager is on the advisory committee of this non-profit center.

Manager: Kathleen Tierney (University of Colorado)

Goal: To influence the disaster management community to utilize social science as a requirements input for disaster management research and applications development.

Activity: Program Planning and Disasters RoundTable

Purpose: Support interagency coordination and activities related to disaster management. Funds to support studies, reports, and other activities sponsored through the RoundTable and other organizations, especially activities related to use of Science results.

Manager: Steve Ambrose

Goal: To influence the disaster management community to utilize social science as a requirements input for disaster management research and applications development.

Activity: Wildfire Management (NV, CA) – DEVELOP activity

Purpose: This 3-D visualization uses Science information to map and monitor invasive and noxious plant species encroaching in the northern Nevada territory and considered wildfire fuel on Native American Lands. Proposed NASA source data: SRTM, ICESat, Aqua

Manager: DEVELOP/Crosscutting Solutions Program Element

Goals: To incorporate NASA satellite data into wildfire management; to demonstrate this capability to the wildfire management community

Activity: Disaster Management – DEVELOP activity

Purpose: To deliver NASA Earth-Sun system science to local communities

Manager: DEVELOP/Crosscutting Solutions Program Element

Goals: To incorporate NASA satellite data into homeland security air plume transport and dispersion modeling to demonstrate this capability to the state homeland security management community.

Activity: Education Fellowships

Purpose: The Education Program funds a number of student fellowships. The projects related to disaster management are monitored and mentored.

Goals: To ensure the results of this Science research are carried forward into the user community.

E. Additional Activities and Linkages

The Crosscutting Solutions Program—The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishment, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- *The Earth-Sun System Gateway* is a “portal of portals” providing an access point through an Internet interface to all web-enabled NASA research results.
- *A Rapid Prototyping Center* is a proposed center at Stennis to support NASA and partners in testing and verification of Earth science results in decision support tools.
- *Transition from Research to Operations Network (R2O)* is a network that focuses on systematically transitioning the results of research to operational uses.
- *DEVELOP* is a student-based program for rapidly prototyping solutions for state and local applications and helping students develop capabilities related to Earth science.

IBS Engineering Support (Funds requested from Crosscutting IBS Program)							
<div>Purpose:</div> <div>1. Refine technical requirements related to the geospatial components associated with NASA Earth observing data products for HAZUS-MH.</div> <div>2. Advise on the selection of NASA Earth-Sun system data products for incorporation into HAZUS-MH.</div> <div>3. Perform V&V of NASA products through use of in situ measurements and ground networks and benchmark product performance through technical publication/memoranda.</div> <div>4. Develop a “checklist” of model attributes that should be examined when comparing and evaluating models for incorporation into HAZUS-MH.</div> <div>5. Perform risk assessments through JPL developed software and risk reduction studies through resources at MSFC.</div> <div>6. Collaborate this work through the efforts of Carbon Management.</div>				<div>Budget</div> <div>(Requested from IBS)</div>			
						FY05	300
				PS Managers	Centers	Timeframe	Partners
Bruce Davis - SSC	SSC	Annual	MSFC, JPL	FY07	300		
				FY08	300		
				FY09	400		
Earth-Sun System Science Products	Identified through HAZUS-MH and evaluation efforts with DHS/FEMA, SSC, JPL, and MSFC			Other Apps.			
				Crosscutting Solutions			
				Carbon Management			
Deliverables	Reports, formal recommendations for action, technical memoranda JPL risk assessment software calibrated and modified to fit the needs of this risk assessment (collaboration with Ed Sheffner).						

NASA and Science Mission Directorate Priorities

- *Federal Enterprise Architecture (FEA)* is a business and performance-based framework to support cross-agency collaboration, transformation, and government-wide improvement.
- *The Global Information Grid (GIG)* is the first stage of a U.S. military global, high-bandwidth, Internet protocol-based communications network (a.k.a., 'the Internet in space').
- *The Joint Center for Satellite Data Assimilation (JCSDA)* is a multi-agency collaboration to accelerate and improve the quantitative use of research and operational satellite data in weather and climate prediction models. NOAA (NESDIS, NWS, OAR), NASA, Navy, Air Force, and NSF (through UCAR) collaborate in JCSDA.
- *Metis* is a visual modeling software tool for planning, developing, and analyzing agencies' enterprise architectures. The Applied Sciences Program is using Metis to identify possible linkages between observations, models, and decision support tools to support the IWGEO and NASA/NOAA R2O activities.
- *Observing System Simulation Experiments (OSSEs)* use simulated observations to assess the impacts of future satellite instruments on weather and climate prediction and provide opportunities to test new designs and methodologies for data gathering and assimilation.
- *Project Columbia* is a NASA-wide project to develop a new, fast supercomputer (using an integrated cluster of interconnected processor systems) to support the Agency's mission and science goals, including enhanced predictions of weather, climate, and natural hazards.

Activity: New Investigator Program (NIP)

Purpose: The Education Program of the Science Mission Directorate supports a number of new investigators.

Goals: To ensure the results of this Science research are carried forward to the user community.

Activity: Space Weather Applications for Disaster Management

Purpose: In support of the sun/earth connection exploration vision, the Disaster Management program is evaluating the benefits of Space Weather research towards improvements to disaster management models and decision support systems.

Activity: Post-Doctoral Research Candidate in support of SENH

Purpose: Under an agreement with the Solid Earth and Natural Hazards Research Program, half of the cost of a post doctoral research candidate will be provided to assist in the analysis of data obtained from the SENH project "Documenting Natural Hazards with Airborne laser Swath Mapping (ALSM)." This project is a joint project with NASA and the USGS to evaluate earthquake hazards in western Washington State. An agreement was signed with John LaBrecque of NASA's Research and Analysis Program to share the cost of \$70K to obtain assistance in the processing, archival, and applications of data obtained from this SENH funded project.

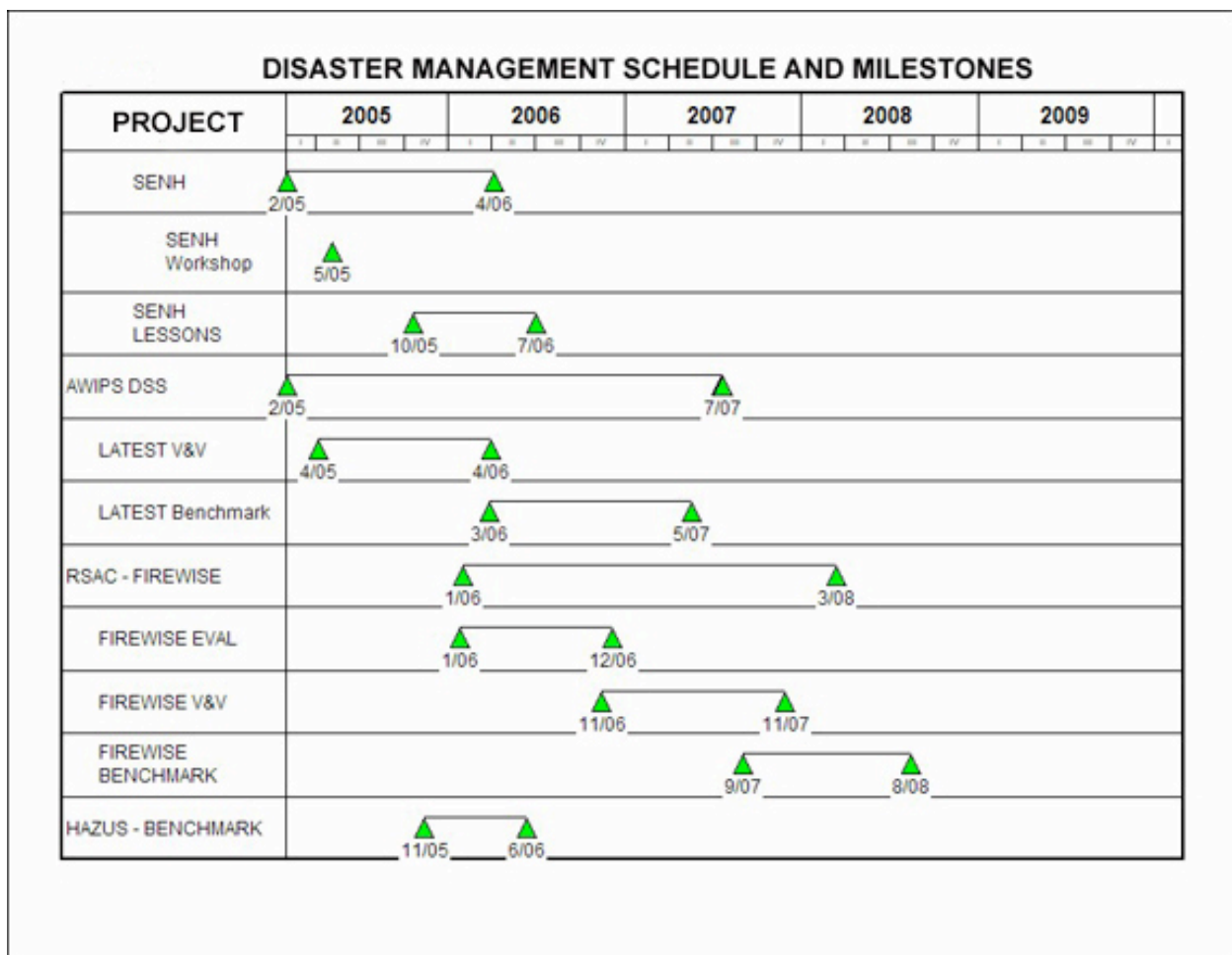
VI. Budget: Fiscal Year 2005

The following table lists the Disaster Management Program budget (procurement) for FY2005:

Disaster Management	
Project	FY05 Procurement Allocation (\$K)
AWIPS Evaluation, V&V (Deferred to FY2006)	\$0
AWIPS, LATEST Project (Year 2)	\$98
SDR, Disasters Roundtable, Hazards Center	\$92
Flood and Landslide Decision Support	\$150
Post Doc, Shared with Research SENH	\$35
SENH Workshop	\$20
Project Flood WSSD	\$150
Total	\$545

Appendix C lists program-wide budget allocations for FY2005.

VII. Schedule and Milestones



VIII. Performance Measures

The Disaster Management team uses performance measures to track progress, to identify issues, to evaluate projects, to make adjustments, and to establish results of the program element. These measures serve as condition indicators to help monitor progress within and across specific project activities to ensure that the Program meets its goals and objectives. The management team continually analyzes these measures, tracking conditions and identifying issues to keep the Program aligned with this Plan to meet its objectives.

The Program uses two performance measures: Program Management measures assess activities within the program, and Performance measures assess whether external program activities are serving their intended purpose. The Applied Sciences Program also uses this information in preparing IBPD directions and U.S. Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) responses.

Performance Management Measures (Internal)

Inputs	Potential issues and DST identified for Disaster Management – <i>number, type, range</i> Eligible partners to collaborate with – <i>number, type, range</i> Potential results/products identified to serve Disaster Management – <i>number, type, range</i> The Disaster Management Program Element will implement steps to populate the Federal Enterprise Architecture Tool (Metis) with all relevant element information.
Outputs	Assessments or evaluations of DST – <i>number, range</i> Assessments of Earth-Sun System Science results/products to serve DST – <i>number, range</i> Agreements with partners – <i>presence</i> Reports (evaluation, validation, and benchmarks) – <i>number, type</i>
Quality and Efficiency	Earth-Sun System Science results/products – <i>number used per DST, ratio of utilized to potential</i> Agreements – <i>ratio of agreements to committed partners</i> Reports – <i>partner satisfaction, timeliness, time to develop</i> Reports – <i>ratio of validations to potential products, ratio of benchmarks to validations</i>

Performance Measures (External)

Outcomes	Science products adopted in DSTs – <i>number, type, range; use in DST over time</i> Science products in use – <i>ratio of products used by partners to reports produced</i> Partner and DST performance – <i>change in partner DST performance, number and type of public recognition of use and value of Science data in DST</i>
Impacts	Partner value – <i>change in partner metrics (improvements in value of partner decisions)</i>

In addition to the stated measures, the Disaster Management Program Manager periodically requests an assessment of its plans, goals, priorities, and activities through external review. The Disaster Management team uses these measures, along with comparisons to programmatic

benchmarks, to support assessments of the Applied Sciences Program (e.g., internal NASA reviews and OMB PART). Specifically, the Disaster Management Program manager uses comparisons to similar activities in the following programs (i.e., program benchmarks) to evaluate its progress and achievements:

- Environmental and Societal Impacts Group at the National Center for Atmospheric Research (NCAR)
- Global Monitoring for Environment and Security (GMES)
- *President's Subcommittee on Disaster Reduction (OSTP/CENR/SDR)*

FY05 Performance Measures Satisfied by the Program – IBPD

This Program demonstrates that it plans to satisfy the following IBPD Performance Measures for FY2005:

Outcome Goal 1.2.1: Through 2012, benchmark the assimilation of observations (geophysical parameters, climate data records) provided from 20 of the 80 remote sensing systems deployed on 26 NASA Earth observation research satellites.

The Disaster Management Program will benchmark at least three (e.g., MODIS, SeaWinds, LIS) of the 20 remote sensing systems from at least three of the 26 Earth observation research satellites. This goal is accomplished through results of the SENH, REASoN, and other projects and moved into operational use through Science tools, models, products, and data.

Outcome Goal 1.2.2: By 2012, benchmark the assimilation of five specific types of predictions resulting from Science Model Framework (ESMF) of 22 NASA Earth-Sun system science models.

Goal 5ESA6 – Crosscutting Solutions: Benchmark solutions associated with at least five decision support systems that assimilate predictions from Earth-Sun System science models developed and maintained by the Goddard Institute for Space Studies (GISS), the Geophysical Fluid Dynamics Laboratory (GFDL), NCEP, SPoRT, and the JPL Science laboratories. The Disaster Management Program currently has linkages with NASA DEVELOP, SYNERGY, and Cross cutting Solutions activities. NASA research laboratories, such as the SPoRT Center, are moving Science research results forward through direct connection with such operational entities as NOAA. The Disaster Management Program also works closely with the USGS in assimilating research results in the solid science areas for the benefit of the user agencies, such as DHS/FEMA.

By 2009, the Disaster Management Program will benchmark solutions to one of the five 5ESA6 decision support systems: HAZUS-MH. The HAZUS-MH decision support system has such flexibility and modularity that it covers at least three of the science research areas – flood, wind, and earthquake – and may cover wildfire in the future. These areas were identified by partners DHS, FEMA, USGS, and NOAA as important areas that can be addressed by Earth-Sun Systems science.

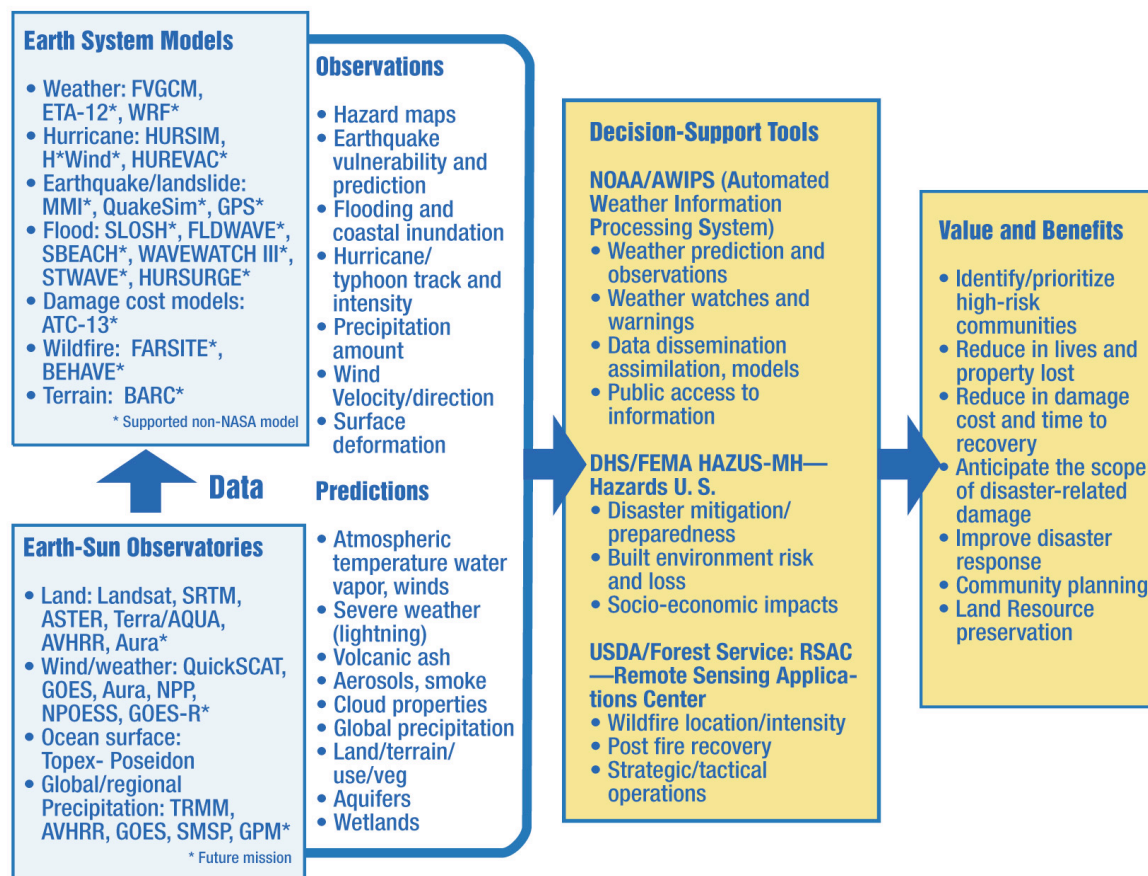
The value of applications in these areas have also been identified in the OSTP Subcommittee on Disaster Reduction policy documents as well as in the strategic plans of the partner agencies.

IX. Appendices

Appendix A. Integrated System Solutions Diagram

Disaster Management Program Management: Integrated System Solutions Diagram

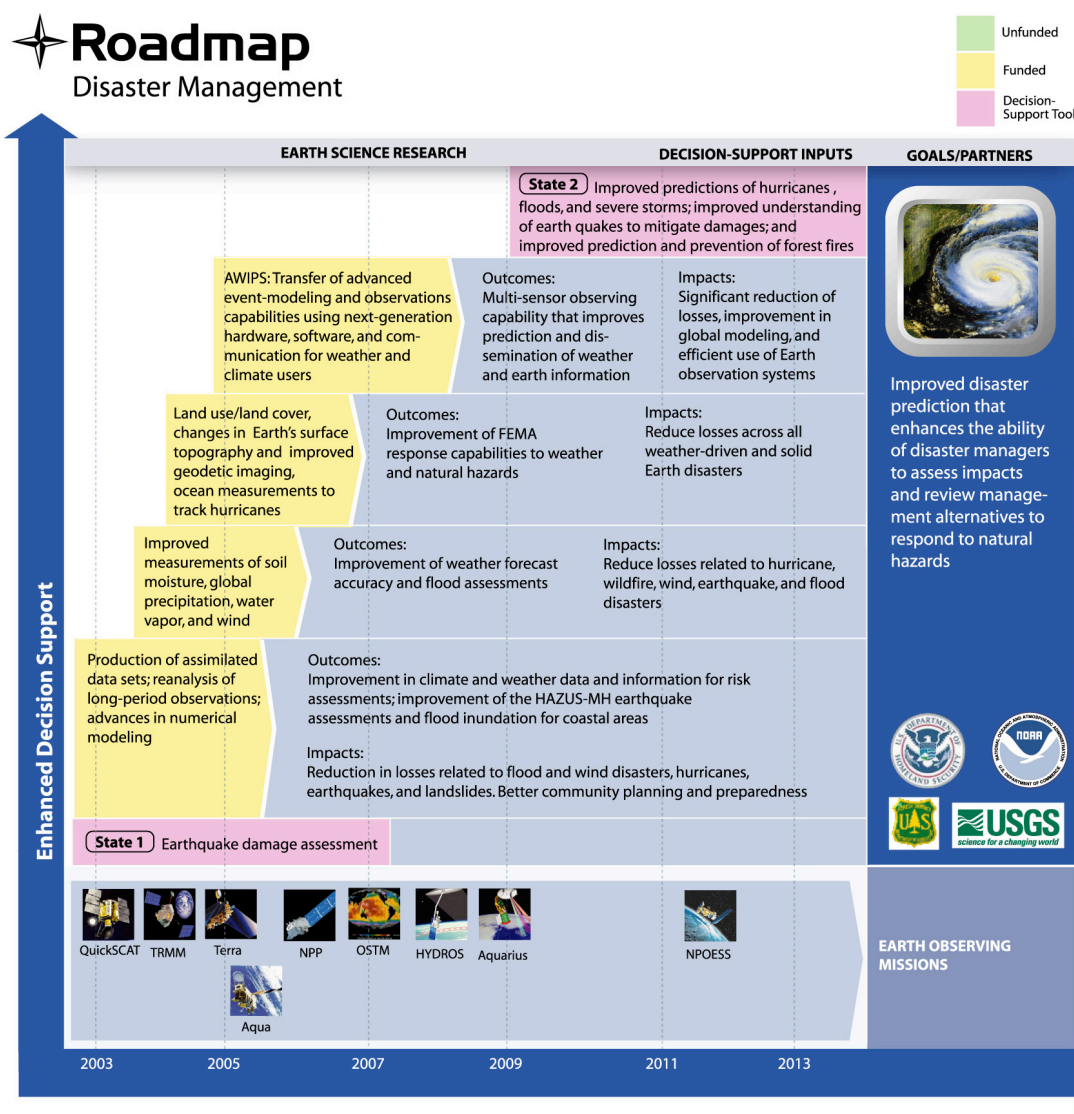
The figure below illustrates how Science measurements, model products, and data fusion techniques support the Disaster Management Program's partners and their decision support tools and shows the value and benefits of Science to society.



Appendix B. Roadmap

The Disaster Management Roadmap shows the migration of NASA Science research results to improvements in risk assessments and loss estimation of the HAZUS Multi-Hazard DST. The Roadmap ties to the priorities and expected plans and results of the Office of Science Applied Sciences Program. State 1 is the ability to use HAZUS-MH for earthquake preparedness and mitigation. State 2 takes HAZUS-MH to the level of wind, flood, severe storms, and wildfire – areas where NASA’s Science research results can be applied effectively. The modularity of HAZUS-MH makes the integration of satellite observations and models useful, but the challenge is the integration of global technologies to regional and local scales.

Science research plays a valuable role in ensuring that NASA’s Science results meet the needs of our partner agencies by integrating technology and science into the hazard response community in a cost-effective and useful manner.



Appendix C: Applied Sciences Program Budget FY2005

The overall program budget allocations are given below to provide the context in which this National Application is conducted. The allocations are based on Agency and program priorities and are subject to change according to the availability of funds and programmatic strategies. All values are in \$ thousands.

*NOTE: Allocations include full utilization of the Applied Sciences FY04 carryover of approximately \$2.7 million.

Table 1: Applied Sciences Procurement Allocation – FY05

Program Element	FY05 Procurement Allocation
National Applications	
Agricultural Efficiency	\$ 467
Air Quality Management	\$ 995
Aviation	\$ 750
Carbon Management	\$ 653
Coastal Management	\$ 550
Disaster Management	\$ 545
SENH	\$ 1,429
Ecological Forecasting	\$ 610
Energy Management	\$ 775
Homeland Security	\$ 205
Invasive Species	\$ 205
Public Health	\$ 725
Water Management	\$ 870
Program Director Discretionary Fund	\$ 588
Center Director Discretionary Fund Tax	\$ 2,485
National Applications Total	\$ 11,852
Crosscutting Solutions	
Integrated Benchmarked Systems	\$ 3,529
Solutions Networks	\$ 1,200
Competitive Solicitations	\$ 7,600
Human Capital Development	\$ 700
Geoscience Standards & Interoperability	\$ 2,000
Crosscutting Solutions Total	\$ 15,029
Applied Sciences Program Procurement Total	\$ 26,881

Table 2: Applied Sciences Program NASA Institutional Allocations – FY05

NASA Center	FY05 Institutional Cost / National Applications	FY05 Institutional Cost / Crosscutting Solutions	Institutional Total
HQ	\$3,773	\$7,351	\$11,124
ARC	\$1,108		\$1,108
GSFC	\$1,009	\$1,094	\$2,103
JPL			
LaRC	\$1,517	\$444	\$1,961
MSFC	\$1,251	\$183	\$1,434
SSC	\$3,194	\$8,689	\$11,883
Total	\$11,852	\$17,761	\$29,613

Appendix D. Related NASA and Partner Solicitations and Grants

Competitive Sourcing and Solicitations

The Disaster Management Program leverages appropriate activities, expertise, and assets selected through other Science Mission Directorate solicitation announcements that serve the Program's objectives; the Disaster Management Program may provide supplemental funding to develop or target specific application-oriented activities in a proposal. The program and project managers facilitate appropriate partnerships between solicitation recipients and application partners.

Solid Earth and Natural Hazards NRA

In FY02, 10 proposals were chosen for FY2003-FY2005 funding from the SENH NRA. The first year of funding in FY03 totaled \$1.58M, FY04 \$1.5M, and FY05 \$1.4M. These projects are listed in the table below. FY05 will be the final funded year for these projects. This year a workshop will be held (May Eros Data Center) to bring the P. I.'s together with others in the applications network to discuss results and how these results can be brought forward to the user community.

PI	Hazard Class	Program Relationship
Brackenridge Dartmouth U.	flood	Flood application based on Science products with outstanding international partnership (WSSD related)
Fielding JPL	subsidence	Land subsidence SAR application pushing the data, technology, applied use to the limit. Utility for InSAR development.
Pieri ARC	volcano	Use of airborne technology for volcano hazard characterization and monitoring (one-year project funded in FY03 only)
Johnson USGS	multihazard	Pushes commercial LIDAR acquisition to limit of technology and industry capabilities.
Arsenault U. of MD	flood/drought	Innovative use of Land Data Assimilation Systems (LDAS) output for flood/drought decision support by reclamation
Sohlberg U. of MD	wildfire	First sustained support for new product/service innovation in MODIS RR. Linked to Sensorweb technologies.
Kasischke U. of MD	coastal	Coastal change study to characterize regional/local sea level change. (Sea Level Change and InSAR related)
Bourgeau Veridian	wildfire	Application of SAR technology for wildfire risk analysis.
Kim U. of CA	flood/wildfire	Advanced utilization of the SCIGN array for flood and wildfire prediction (GPS seismic network)
Bock U. of San Diego	seismic	Unique real-time civilian infrastructure strain monitoring applications of SCIGN array (GPS seismic network)

The success of these projects is determined through periodic monitoring and contact, guiding the researchers to obtain significant results in alignment with program goals, and providing these results to the research and applications community.

Appendix E. Acronyms and Websites

ACRONYMS:

AIRS	Atmospheric Infrared Sounder
AIWG	Applications Implementation Working Group
AMSR-E	Advanced Microwave Scanning Radiometer-EOS (Japanese)
ARA	Applied Research Associates
ARC	Ames Research Center
ARGIS	ESRI GIS Software]
ARCFORREST	ESRI Based Forest Decision Support System in Canda
AWIPS	Advanced Weather Interactive Processing System
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CEISC	Committee on Environmental Information Systems and Communications
CEISIN	Consortium for International Science Information Network
CENR	Committee on Environment and Natural Resources
CEOS	Committee on Earth Observation Satellites
COE	Corps of Engineers
CSTARS	Center for Southeastern Tropical Remote Sensing
DEVELOP	No longer an acronym
DHS	Department of Homeland Security
DSS	Decision Support Systems
EPA	US Environmental Protection Agency
ESA	Earth Science Applications
ESG	Earth-Sun Gateway
ETA	Event Tree Analysis
ETM	Enhanced Thematic Mapper
FAA	Federal Aviation Administration
FARSITE	Forest Service Fire Decision Support System
FEA	Federal Enterprise Architecture
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FIREWISE	Forest Service Fire Decision Support System
FS	Forest Service
FY	Fiscal Year
GCM	Global Climate Model
GCOS	Global Climate Observing System
GEO	ad hoc Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GDIN	Global Disaster Information Network
GFDL	Geophysics Fluid Dynamics Laboratory
GIG	Global Information Grid
GIO	Geospatial Interoperability Office
GIS	Geographic Information System
GISS	Goddard Institute for Space Studies
GLOBE	Global Learning and Observations to Benefit the Environment
GMES	Global Monitoring for Environment and Security
GOS	Geospatial One Stop
GPM	Global Precipitation Measurement
GPS	Global Positioning System

HAZUS	Hazard- United States
HAZUS-MH	Hazard- United States - Multi-Hazard
HIU	Humanitarian Information Unit
HPCC	High Performance Computing and Communications
IAGT	Institute for Applications of Geospatial Technologies
IBPD	Integrated Budget and Performance Document
IBS	Integrated Benchmarked Systems
ICMSSR	Interdepartmental Committee for Meteorological Services and Supporting Research
ICESat	Ice, Cloud, and Land Elevation Satellite
IGOS	Integrated Global Observations strategy
IMAAC	Interagency Modeling and Atmospheric Assessment Center
IMPLAN	Economic Input/Output model for fire cost assessment
INFORMS	Institute for Operations Research and the Management Sciences
INSAR	Interferometric Synthetic Aperture Radar
IOC	Intergovernmental Oceanographic Commission
IPO	Interagency Program Office (NPOESS)
ISRSE	International Symposium for Remote Sensing of the Environment
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
JPL	Jet Propulsion Laboratory
LANDFIRE	Land forest fire decision support system
LANDIS	Land fire probability model
LaRC	Langley Research Center
LDAS	Land Data Assimilation System
LIDAR	Light Detecting and Ranging
LIS	Lightning Imaging Sensor
MAGIS	Analytical Tool for Measuring fire extent (used with SIMPPLLE)
MIT	Massachusetts Institute of Technology
MLRRS	Modis Land Rapid Response System
MM5	Mesoscale Model
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MSFC	Marshall Space Flight Center
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NED	Northeast Decision Model
NEESPI	Northern Eurasia Earth Science Partnership Initiative
NESDIS	National Environmental Satellite Data Information Service
NIBS	National Institute for Building Sciences
NIERSC	Nansen International Environmental and Remote Sensing Center
NIFC	National Interagency Fire Center
NOAA	National Oceanic and Atmospheric Administration
NOAAPort	NOAA Data Portal for AWIPS
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project/Net Primary Productivity
NRA	NASA Research Announcement
NRC	National Research Council
NSF	National Science Foundation
NWS	National Weather Service

OFCM	Office of the Federal Coordinator for Meteorology
OMB	Office of Management and Budget
OMI	Ozone Monitoring Instrument
ORA	Office of Research Applications
OSTP	Office of Science and Technology Policy
PART	Program Assessment Rating Tool
QuikSCAT	Quick Scatterometer
R&D	Research and Development
R2O	Research to Operations Network
RACNE	Regional Applications Center for the Northeast
RAINS	Rapid Assessment Information System (Forest Service)
REASoN	Research, Education, and Applications Solutions Network
RELMdss	Regional Ecosystems and Land Management (RELM). Decision Support
RFC	River Forecast Centers
RIT	Rochester Institute Technology
ROSES	Research Opportunities in Space and Earth Sciences
RSAC	Remote Sensing Applications Center
RSAWG	Remote Sensing and Applications Working Group
SAIC	Science Applications International Corporation
SAR	Synthetic Aperture Radar
SARA	Superfund Amendments Reauthorization Act
SCIGN	Southern California Integrated Global positioning system Network
SENH	Solid Earth Natural Hazards
SDR	Subcommittee on Disaster Reduction
SEDAC	Socio Economic Data and Application Center
SERVIR	Regional Visualization and Monitoring System for the Mesoamerican Biological Corridor
SESWG	Solid Earth Science Working Group
SIMPPLLE	Simulating Patterns and Processes at Landscape Scales Acronym
SNAP	Special Needs Awareness Program
SPECTRUM	Analytical Tool to Support Ecosystem Management
SPoRT	Short-term Prediction Research and Transition Center
SPOT	French Satellite which Collects Information on Arousal and Ozone
SRTM	Shuttle Radar Topography Mission
SSC	Stennis Space Center
SSD	Satellite Services Division
SYNERGY	Congressionally Mandated Program
THORPEX	The Observing-System Research and Predictability Experiment
TerraVision	interactive terrain visualization system
TOPEX/POSEIDON	Satellite from JPL with Five Instruments
TRMM	Tropical Rainfall Measurement Mission
UCAR	University Corporation for Atmospheric Research
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USWRP	United States Weather Research Program
UTOOLS	Microcomputer Software for Spatial Analysis and Landscape Visualization
V&V	Verification and Validation
VIIRS	Visible/Infrared Imager/Radiometer Suite
WASP	Wildfire Airborne Sensor Program
WAVEWATCH III	Ocean Wave Model

WCDR	World Conference on Disaster Reduction
WFO	Weather Forecast Office
WMO	World Meteorological Organization
WRAP	Wildfire Research and Applications Project
WRF	Weather Research and Forecast
WSSD	World Summit on Sustainable Development
WWRP	World Weather Research Program

WEBSITES:

Research Opportunities in Space Science (ROSS):

http://research.hq.nasa.gov/code_s/nra/current/NNH04ZSS001N/index.html

AIWG: <http://aiwg.gsfc.nasa.gov/>

Applied Sciences Program: <http://science.hq.nasa.gov/earth-sun/applications>

DEVELOP: <http://develop.larc.nasa.gov>

Earth-Sun System Gateway (ESG): <http://esg.gsfc.nasa.gov/>

Earth-Sun Science System Components: <http://www.asd.ssc.nasa.gov/m2m>

NASA FY2005 Budget: <http://www.ifmp.nasa.gov/codeb/budget2005>

Research and Analysis Program: <http://science.hq.nasa.gov/earth-sun/science/>

Science Mission Directorate: <http://science.hq.nasa.gov>

Science Strategies: <http://science.hq.nasa.gov/strategy/>